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China Report

POLITICAL, SOCIOLOGICAL AND MILITARY AFFAIRS

INTRODUCTION TO NATIONAL DEFENSE MODERNIZATION

CHAPTERS VIII, X

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CHAPTERS VIII, X

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CONTENTS

Chapter 8: Protection Against Nuclear, Chemical and Bacteriological Weapons

[Text] Modern warfare can be conventional, but it can also be nuclear. The two superpowers--the United States of America and the Soviet Union--are not only competing in developing and stockpiling a large number of nuclear, chemical and bacteriological weapons, but are also using them as tools in wars of expansion and aggression. Thus, we must set the footing of our war preparedness on the premise that the enemy will possibly use nuclear weapons and will widely employ chemical weapons in order to do a good job of protection against them in all aspects.

I. Nuclear, Chemical and Bacteriological Weapons Under Development

In order to help the general public recognize these weapons so that it can purposefully prepare to protect itself against them, it is necessary to introduce their functions, properties and powers before bringing in the knowledge about protection. Since we have already discussed strategic nuclear weapons in the preceding chapter, only tactical nuclear weapons are presented in this chapter.

1. Broader Use of Tactical Nuclear Weapons

Nuclear weapons have a history of 37 years since they were first brought into being. Both superpowers have made an impressive achievement in the development of nuclear weapons during this period, and the ongoing trend in general is that they are shifting the focus of their competition from the quantity to the quality of these weapons. Before the 1960s, the competition for quality mainly involved the development of strategic nuclear weapons with emphasis on the production of a class of heavy duty nuclear bombs having an equivalent of several hundred thousand tons to ten million tons. Since the beginning of the 1970s, this has been replaced by the development of small and extra small tactical nuclear weapons for broader offensive and tactical use. Reportedly, the U.S. has successfully developed nuclear bombs of a 10-ton equivalent, while the Soviet Union, unwilling to lag behind, has been able to produce nuclear bombs whose equivalent is as small as 100 tons. This type of nuclear bomb can be made into not only nuclear shells to be launched by large caliber guns but also nuclear land and submarine mines tc strengthen the antipersonnel firepower of weaponry and the barrier system.

Since the turn of the 1970s, while continuing to develop nuclear mini-weapons, the two superpowers have been concentrating their efforts in the direction of developing "diversification of bombs" in order to increase the battlefield use of various types of nuclear weapons. At present, they have developed, or are developing, the following types of nuclear bombs:

Neutron bomb (aka reinforced radiation bomb): Its main feature is its small equivalent of around 1,000 to 2,000 tons, thus increasing the function of early-stage nuclear radiation and decreasing that of shock wave and light radiation. Foreign military people consider it particularly suitable for eliminating lives inside armored targets.

Nuclear shock wave bomb: Exactly contrary to the neutron bomb, it converts a large amount of neutron energy into a shock wave effect and greatly reduces radiative contamination during the flash of explosion. This type of weapon is used mainly to destroy sturdy targets of a smaller size on the battlefield, such as an underground command post, guided missile silo or nuclear ammunition depot, and has an insignificant impact on the user's own military actions.

Induced radiation bomb: It utilizes a special neutron-absorbent material to produce short-term (several hours to several days) radiation and to cause severe radiative contamination on the ground. This type of weapon is used mainly to hinder the enemy in its entry to a certain area or movement through certain important passes and to restrict the opponent's combat actions, thus achieving due offensive and tactical goals.

Drilling nuclear bomb: It is used mainly to destroy underground targets on the battlefield. This type of bomb currently developed by the U.S. is reportedly able to reach a maximum depth of 60 meters.

From the information stated above we can see that there has been an unprecedented increase in the variety of nuclear weapons. In addition to strategic nuclear weapons, there are various types of tactical nuclear weapons which, like the former, can cause tremendous casualties and destruction when used in the battlefield in future wars.

2. After the "Ypres Gas War"

During the early period of World War I, the German and French forces were fighting at Ypres, Belgium. On 22 April 1915, in order to turn around a situation unfavorable to them, the Germans took advantage of the speed and direction of the wind to launch a surprise attack by blowing 180 tons of chlorine (an asphyxiating agent) contained in 30,000 steel cylinders toward the French side. In a moment, the yellow-greenish poisonous gas in a width of 6 to 8 km was moving 10 to 15 km deep into the French position and knocking down panic-stricken French soldiers, of whom 5,000 were killed and 15,000 injured. It was the historical famous "Ypres Gas War" and also the scene of the first employment of a chemical weapon on the battlefield by mankind with a tactical effect.

Since the "Ypres Gas War," in order to achieve victory on the battlefield, many belligerent countries have developed and employed chemical weapons one after another, leading to frequent battlefield use of gas for attack. During World War I, despite various protective measures designed by all belligerent countries at that time, chemical weapons still killed or injured 1.3 million people, making up 5.6 percent of the total casualties. Major toxic agents used in this war included chlorine, phosgene, biphosgene, mustard gas, lewisite, hydrocyanic acid, chloroacetophenone and adamite. In some subsequent wars, especially those staged by strong countries for invasion of weak ones, the use of chemical weapons never ceased. During their invasion of China, for example, the Japanese forces frequently used poisonous agents against our soldiers and civilians and, as incomplete statistics show, this happened more than 1,000 times.

Chemical weapons comprise mainly guided missiles (rockets), bombs, shells and mines containing toxic agents, toxic smoke containers and airplane sprayers. As toxic clouds formed after the explosion of a toxic bomb can ride the air current to "trail" a target rapidly, personnel on the battlefield, whether exposed or covered, are likely to be injured if they do not seek timely protection. Generally, a toxic agent can cause injury to personnel in two ways--toxic clouds and drops entering the respiratory tract or poisoning the skin.

Compared with those during World War I, modern chemical weapons have been greatly improved. Major toxic agents of identifiable models and serial numbers that the U.S. and the Soviet Union use to equip their troops are as follows:

Nerve toxic agent: This is used mainly to destroy the normal functions of the human nervous system and causes myosis, difficulty in breathing, and cramping. The major ones include, sarin, soman and tabun. As it is quite poisonous and has fast effects, this type of toxic agent can kill its victims in a short period of time if treatment is not given immediately. Hence it is also called a quick-killing toxic agent.

Blistering toxic agent: This is used mainly to damage human skin and causes swelling, vesication and ulceration as well as internal poisoning. Mustard gas and lewisite are examples of this type of toxic agent.

Whole body toxic agent: This is used mainly to destroy the oxygenation of organic cells and causes myosis, reddening of the skin and the rigid cramping. This type of toxic agent includes hydrocyanic acid and cyanogen chloride.

Asphyxiating toxic agent: This is used mainly to damage the lungs and causes difficulty in breathing, pulmonary edema and asphyxiation. Phosgene is an example of this type of toxic agent.

Incapacitating toxic agent: This is used mainly to incapacitate the functions of thinking and movement and causes the victim to be temporarily distraught and lethargic. This type of toxic agent includes BZ.

Irritant toxic agent: This is used mainly to irritate the eyes and windpipe and causes such symptoms as tearing and sneezing. This type of toxic agent includes CS, CR, chloroacetophenone and adamite.

The six types of toxic agents listed above are classified based on their poisoning effects, but they can also be divided into temporary and lasting toxic agents in terms of the length of their effects. Mustard gas, for example, is a typical lasting toxic agent.

In order to make toxic agents most effective when employed on the battlefield, both the U.S. and the Soviet Union are vigorously developing new types which are severly poisonous, multifunctional and unable to be easily countered by protective measures. The Soviet Union is reported to have invented a new type of nerve toxic agent and "NK" incapacitating

toxic agent and a chemical weapon called "double channel." This weapon comprises two kinds of lethal compounds--one able to penetrate human skin to destroy the blood circulatory system and cause suffocation, and the other able to produce a toxic gas at the time of explosion to poison human targets. According to the foreign press, the Soviet Union used a new type of toxic agent called "yellow rain," which is a fungous toxic element, in its invasion of Afghanistan and supplied it to the Vietnamese troops when they took over Kampuchea. This toxic agent can go through the victim's respiratory tract and skin to cause poisoning, vomiting, discharge of blood and vesicating of the skin until he dies. At the same time, the U.S., unwilling to be outdone by its Soviet rival, is aggressively developing a so-called "dual-element chemical weapon." It is a warhead filled with two kinds of nonpoisonous compounds which begin to mix after launch and become a toxic agent through a chemical reaction. Its distinguishing features are that it is easy to produce, safe and reliable, storable for a long time, able to be transported unrestrictedly, and is multidiversified for projection, thus it can be contained in all kinds of shells, bombs, guided missiles and rockets.

A comparison of the two superpowers shows that the Soviet Union holds the edge over the U.S. in the pace of development of chemical weapons, and the consensus of military experts in western countries places the Soviet capability in chemical warfare in the leading position.

3. Today's Bacteriological Weapons

What is a bacteriological weapon? All types of guided missile warheads, bombs and shells filled with bacteriological warfare agents and aerosol generators are called bacteriological weapons. All disease-inducing microbes (such as germs, viruses or rickettsiae) used in wars to injure human beings and animals and destroy crops and all types of poisonous elements produced by germs are called bacteriological warfare agents.

In the history of wars, there have been many cases in which a bacteriological warfare agent was used as a type of weapon on the battlefield to carry out bloodless killing and eliminate a large number of lives. For example, in October 1940 the Japanese militarists air-dropped plague bacillus-carrying wheat grains in Ningbo, Zhejiang, which caused 103 people to suffer from the plague and 102 of them to die in one month's time. In April 1952, the U.S. Air Force covered a 15-square kilometer area in Gannan, Heilungjiang with air-dropped voles carrying the plague bacillus, but the conspiracy was foiled after our military personnel and civilians took effective measures against it. During the invasion of Korea, the U.S. employed various types of bacteriological warfare agents, including germ-carrying insects (such as flies, fleas, midges, etc.), germ-carrying animals (such as voles, frogs, fishs, etc.) and germ-treated leaves and miscellaneous items. Germs used were the plague bacillus, anthrax bacillus, cholera bacillus, etc.

Today, the U.S. is still vigorously developing all types of bacteriological weapons, as it did three decades ago. Between 1971 and 1977 it spent over $10 million on the development of such weapons every year. To

establish world hegemony, the Soviet Union is also stepping up its development of bacteriological weapons. According to estimates by western countries, the Soviet Union has more than ten institutions and plants for studying, testing and producing bacteriological weapons and has stockpiled a considerable quantity of them. In terms of bacteriological warfare agents, they have been developed from monogenetic germs to a variety including disease-inducing microbes containing viruses and rickettsiae and a toxin whose size is much smaller than that of a germ.

These bacteriological warfare agents are disseminated via aerosol, insects, animals or polluted food and water, and the damage done to human beings and animals by them is characterized by being widespread, highly disease-inducing, contagious and lasting, and having a definite incubation period.

Judging from the ongoing situation between the U.S. and the Soviet Union, we can anticipate that application of aerosol warfare agents will be the major form of their development of bacteriological warfare agents. An aerosol agent is colorless and tasteless, invisible to the human eye, and highly pervasive. A dose of it used to cause a human death through infection of the respiratory tract is ten times less than that of a different agent causing another type of infection. Of note is the fact that in order to intensify the damaging effects of bacteriological warfare agents, the two superpowers have also developed certain disease-inducing microbes that can enter the human body without going through the respiratory tract.

II. Three-Defenses in Modern Warfare

Three-defenses is the abbreviation for defense against nuclear weapons, defense against chemical weapons, and defense against bacteriological weapons. These three types of weapons are large-scale antipersonnel and destructive weapons mainly for battlefield use, but they can also be employed in rear areas to cast a significant impact on the combat actions of the troops and the course of the war. Hence, to provide protection against them is a matter concerning not only the three services of a country's armed forces, but also all of its people. Good protection should be extended to its resources and things on the ground as well. Only by doing this can a country's potential for war be preserved and the combat capability of its troops be upheld. Thus, three-defenses has become an important part of strategic, tactical and combat security in modern warfare.

As proven by practice in war, defense against nuclear, chemical and bacteriological weapons is feasible, but whether a country is prepared for them or not would make a big difference. The loss of several hundred thousand lives in the atomic bombings of Hiroshima and Nagasaki was attributed to the fact that Japan was caught totally unprepared, both psychologically and protection-wise. Even so, the casualty rate among people who were inside buildings or concrete constructions at the time of the bombing was much lower than that among those who were outdoors.

In the Ypres Gas War, the French troops suffered heavy casualties because they did not believe that gas could be so powerful and had made no prior preparation, and they did not have the needed knowledge for protection. In contrast, they also attacked the German soldiers with poisonous gas for seven consecutive days during the late period of World War I, but there were no heavy casualties or serious cases of poisoning because Germany had paid attention to protection against chemical weapons and had already equipped its troops with antigas gear. During the Korean War, the U.S. forces disseminated insects and other objects carrying germ warfare agents on the battlefield in Korea and in Manchuria as many as 4,500 times, but as the Chinese and Korean troops and civilians rapidly took a series of effective countermeasures and carried on a struggle against germ warfare, they could reduce the losses to a minimum and foil the enemy's conspiracy. These instances prove that as long as well-prepared protection is made available at all times and protective measures are adopted in a timely manner, we can effectively avoid or minimize the losses caused by these weapons.

To achieve effective protection against these three types of weapons, we need not only employ all kinds of means to smash or destroy them, but also organize well a tight defense and protection system and simultaneously carry through the principle of making mass protection the center of the system and intensify the protection conducted by specialized troops. Only by mobilizing and relying on the masses to participate can we effectively accomplish the mission of providing defense and protection against these weapons. In terms of means of protection, we need not only to be skillful in utilizing advanced technical equipment, but also to develop extensively a simple defense and protection in line with local conditions.

1. Positive Destruction--the Most Effective Means of Protection

The guiding principle for all military actions lies in "preserving our own strength and eliminating the enemy's as much as we can." Positive destruction is the application of this principle to the matter of three-defenses. With forestalling the enemy as the starting point of positive destruction, we should first take all means of reconnaissance to make a timely determination of the enemy's deployment of nuclear, chemical and bacteriological weapons, its attempts at using them, and its state of readiness, especially taking note of signs indicating that the enemy is ready to use them. Once the enemy is known to possess these weapons and to be ready to use them, we must positively organize all types of effective firepower and means to destroy them. Of all targets, those that will give the most threat to our troops and leading party and administrative institutions are to be destroyed first.

Warnings given by modern reconnaissance satellite, early warning satellite, ultrastadia radar, long-range surveillance radar or surface-to-air guided missile, the development of weapons and equipment for interception, and the formation of national or regional

early warning networks have made the destruction of nuclear, chemical and bacteriological weapons a reality. An ordinary radar station can monitor an area of a radius of several hundred kilometers and detect raiding enemy guided missiles and airplanes in time, while long-range, highly precise and powerful guided missiles for air defense can destroy them at a farther distance. Radio frequency signals emitted by high-grade electronic jamming equipment can deflect incoming enemy guided missiles from their direction and cause them to miss their targets.

On the battlefield, the firepower of guided missile (rocket) units, air force and long-range artillery troops should be organized to destroy the enemy's nuclear, chemical and bacteriological weapons as soon as they are discovered either in the strategic range or in the tactical range. When necessary, we can dispatch surprise attack teams composed of paratroopers and armored forces to the enemy's rear area or organize local armed troops, militia and guerrilla forces to attack and destroy the enemy's ammunition depots, command and control facilities and positions for the launching of these weapons. Along with the development of military science and technology, the means of reconnaissance and destruction will certainly become better and more effective.

2. Building Sturdy and Reliable Three-Defense Constructions

In order to weaken the antipersonnel and destructive effects of nuclear, chemical and bacteriological weapons in modern wars and to ensure preservation of an armed forces' effective strength and a country's potentialities for war, it is necessary to build constructions for national defense and protection of the people. In China, building tunnels in hilly areas as ever-ready protective constructions and underground air shelters has become an important measure of war preparedness to counter an enemy attack by nuclear, chemical and bacteriological weapons and consolidate the country's national defense. Many other countries are also building this type of construction, and some of them are even spending an enormous amount of money on building underground airports, underground stations, underground wharves and underground cities. By so doing they can not only preserve their military strength, but can also achieve the goal of waiting for the right time to strike the enemy.

Scientific tests at home and abroad have proven that constructions for command, combat, stationing of troops (concealed assembly), communication, sanitation, production, etc. equipped for three-defenses are effectively protected against nuclear, chemical and bacteriological weapons. The main reason is that various types of protective devices are installed on the roofs. These generally consist of highly pressure-resistant protective valves and airtight protective valves to counter shock waves; anti-explosion valves to stop shock waves from entering the ventilation system of the construction; a diffusing chamber to cushion and weaken the pressure from shock waves; airtight and counter-poison valves and windows to prevent the passage of toxic

gas; filtering and ventilating devices to filter radiative substances, toxic agents and bacteriological warfare aerosol; cleansing and disinfecting devices to carry out personnel disinfection and elimination of contamination; automatic alarm and control equipment to transmit signals for a surprise attack and activate the filtering and ventilating device with a relay; and various kinds of monitors and testers to monitor and test the efficacy of protection for the construction. A defensive and protective construction equipped with the devices described above can not only defend itself against attack by nuclear, chemical and bacteriological weapons and protect the normal activities of the personnel stationed in it, but can also turn itself into an installation for combat with the enemy.

To build sturdy and reliable constructions for three-defenses is a matter concerning all military personnel and civilians as it requires the consumption of a large quantity of money, material and time; thus it is necessary to mobilize and rely on the masses to wage a large-scale people's war. Even those strategically important places that are well protected against surprise attacks still use a lot of protective equipment, but the demand can hardly be met merely with standard equipment. Therefore, we need to collect extensively and produce simple equipment to carry out unsophisticated but effective protection. For example, grains of clay, clay/limestone particles, sawdust and wood powder can be used as filtering materials to make a simple poison-filtering and ventilating device since they can play the role of a filter like those regular materials.

3. Individual Protective Equipment Under Modern Conditions

Since it is not sufficient to have only sound collective protective equipment when we are fighting an enemy using nuclear, chemical and bacteriological weapons, we also need individual protective equipment of reliable performance to protect freedom of movement on the battlefield of both military personnel and civilians. Individual protective equipment has the function of guarding personnel against injury caused by toxicants, bacteriologcal warfare agents and radiative substances. The major types include gas masks, protective clothing (radioactive-dust-proof garments), protective gloves, protective rubbers, personal disinfecting kits and simple detecting devices.

A gas mask is used mainly to protect the human respiratory organs, eyes and face against injury caused by toxicants, bacteriological warfare agents and radiative substances. In terms of the theory of function, there are two types: a filtering mask and an isolating mask. The former is generally composed of a facepiece and a filtering canister and some kinds contain an air tube. Inside the canister are a smoke filter and counterpoison charcoal (chemically treated activated charcoal). Contaminated, harmful air becomes purified, harmless air after being filtered in the canister for the wearer to breathe. The isolating mask contains an oxygen-generating device to replace the filtering canister to supply oxygen to the wearer. Members of the army, navy and air force

and special troops are equipped with special gas masks. Regardless of the type, a gas mask definitely causes discomfort to its wearer after a long time and affects his command of combat, observation for shooting and communication with other people. In order to minimize these problems, many countries are vigorously improving the structure of the gas mask and upgrading its tactical and technical performance. The new "XM29" model developed by the U.S., for example, not only has a better protective effect against toxic agents, but also gives the wearer a broadened field of vision allowing him unhindered use of binoculars, aiming devices and night vision equipment. It also provides the wearer with a strong capability for communication and allows him to eat while wearing it. This type of gas mask is suitable for members of all services of the armed forces and special troops.

Protective clothing is used mainly to protect personnel against bodily injury received from toxicants and contamination by radiative substances and bacteriological warfare agents. The two types currently used by all countries to equip their military personnel are ventilated and nonventilated. The former (made of cotton) is better for ventilation and heat resistance; the latter (made of rubber) performs well for toxicant resistance but can easily tire the wearer out. The British-made "MK3" protective clothing, for example, can protect the wearer from injury caused by toxicants either in gaseous or liquid state that penetrate the human skin. Modern protective clothing can resist high temperature and light radiation generated by a nuclear explosion and can also be used as combat clothing. The majority of the NATO nations equip their troops with this type of protective clothing.

To cope with operations under modern conditions, the U.S. has developed collective protective equipment for its armored combat vehicles, and the Soviet Union has installed an air filtering system on its armored combat vehicles to counter toxicants and radiative substances. Both countries have produced antiblindness protective eyeglasses that can protect the eyes from injury caused by the flash in a nuclear explosion. In addition, they have made medicines to avoid or reduce damage done by toxicants, bacteriological warfare agents and radiative substances and first-aid injections to relieve pain from poisoning.

The demand for and consumption of gas masks in wartime are huge and cannot be fully satisfied by standard equipment; thus, protection of the broad masses must be done in line with local conditions, such as extensive use of industrial masks, making simple canister and gauze masks to protect the respiratory tract, and utilizing raincoats and plastic fabric to guard the skin. Although not elaborate, these devices for individual use can effectively protect personnel.

Basically, the aforementioned individual protective devices are not able to protect personnel against shock waves, light radiation or early stage radiation generated by a nuclear explosion. Thus, as generally required, personnel should enter defense works or get protection from local topography as soon as they hear the alarm for a

nuclear attack or see the flash of a nuclear explosion. When in an open field where there is no usable topography for protection, they should immediately seek protection by taking a prone position with hands crossed under the chest, elbows stretched forward, head buried between the arms, eyes and mouth closed, and legs straight and not split apart.

4. Establishing a Close Observation Network and Informing Service

In war, in order to detect signs of an enemy nuclear, chemical or bacteriological attack in time, observe the situation and obtain and assess the materials regarding the consequences, thereby providing the basis for the command of troops and organization of protection, it is necessary to establish and consolidate a close observation network and informing service and dispatch observation sentinels for nuclear and chemical attacks at the right time to conduct continuous observation for areas under protection.

Observation sentinels for a nuclear attack have the responsibility of observing and monitoring the situation of the enemy's nuclear attack and estimating the range and degree of its antipersonnel and destructive power and radiative contamination. All developed countries are paying attention to this task now, and, in addition to improving the equipment for observation and estimation continuously, they are in fact studying ways to form a nuclear explosion observation system in one war zone or the whole country.

At present, the equipment for observation and estimation of a nuclear explosion is mainly divided into two types: automatic and non-automatic. Non-automatic observation equipment is manually operated and relies on the human eye to accomplish the objective of collecting data; automatic observation equipment can self-start its operation and utilizes signals from shock waves, light radiation and early stage nuclear radiation to measure and record related parameters. Major instruments mounted on the equipment for estimation include the special-use computer, nuclear explosion calculation disc, anti-atom estimating disc and nuclear radiation slide rule. Some advanced countries are now vigorously developing and all-automatic system which links observation, estimation and display into one operation. For example, France has developed a "system for observing and locating nuclear explosions" which determines nuclear explosion-related parameters by measuring the explosion's special optical, electromagnetic and acoustic features and the relations among them in terms of space and time, processes all the data with its computers and shows the findings on its display screen. During wartime, in order to establish a close nuclear observation system, the radar stations and instruments for observation and communication operated by all services of the armed forces should be given full play in their role as monitors and observers of the situation of an enemy nuclear attack.

Observation sentinels for a chemical attack have the responsibility of detecting and reporting the situation of chemical and bacteriological warfare agents through chemical detectors and lasers and infrared

instruments, or they discover and measure radiative contamination on the ground and the extent of its irradiation through a radiation detector, and then summarily find out certain signs of a chemical attack (for example toxic bombs have a low sound of explosion, shallow crater, light-colored cloud and whistling shells) or certain signs of a bacteriological attack)for example an airplane sprays smoke and throws special containers and a large number of insects appear in the area) through human sensory organs.

Informing signals are generally divided into early warning, alarm and all clear. Early warning is made to give a timely alert to troops and civilians in general that enemy use of nuclear, chemical or bacteriological weapons is imminent so that they can get prepared for protection. An alarm is sounded for troops and residents in the war zone immediately after they are found to be under direct threat from those weapons so that they can take appropriate protective actions. Generally, all types of informing signals are efficiently and rapidly released in time and relayed by various kinds of communication devices.

5. Detecting Instruments for Testing Nuclear, Chemical and Bacteriological Warfare Agents

After its attack with nuclear, chemical or bacteriological weapons, the enemy can have radiatively contaminated, poisoned or polluted the ground, air and objects in the area with harmful substances which are generally not visible to the human eye. To determine the characteristics of those substances and the degree and range of damage caused by them, we must rely on various types of special instruments for monitoring and testing chemicals, radiation and bacteriological warfare agents to examine them. Only by doing this can we conduct protection and first aid directly against those weapons and eliminate the consequences therefrom and, meanwhile, provide commanders with the bases for directing the combat actions of the troops under them.

Along with the development of science and technology, various kinds of special instruments to detect and examine chemical, bacteriological and radiative weapons have been made available one after another and their performances are being continuously improved. Currently, the major ones are:

A. Instruments to detect chemical weapons

Toxin alarm: It is an instrument to detect and monitor toxic agents in the air by the application of chemical and physical theories to send warning signals through light or sound. The U.S.-made "M8" toxin alarm, for example, uses the theory of spontaneous electrolysis to give an alarm against nerve toxic agents, asphyxiating toxic agents and whole body toxic agents.

Toxin detector: It is an instrument to determine first whether or not a toxin exists in an agent and then to determine the type of toxin by the color developing in the chemical reaction after the agent is mixed with a testing agent. This instrument can detect various kinds of toxins on the ground, in the air, and on the surface of an object.

Laboratory test vehicle (laboratory test box): It is used to carry out qualitative and quantitative analyses of toxins and also to examine any new toxic agent found on the battlefield.

B. Instruments to detect radioactive weapons

There are various types in this category such as the ray alarm, nuclear explosion alarm, radiograder, multi-purpose meter, individual dosimeter, aerial detector, and four others, all serving the role of an alarm for three-defenses. A ray alarm can emit light and sound signals when the ground radiation rate reaches 5 milliroentgen/hour. A nuclear explosion alarm gives warning signals through the energy produced by the instantaneous radiation of gamma rays, the overpressure of shock waves and the light radiation of the explosion. A radiograder can measure the ground radiation rate (the radiation grade) and the degree of contamination on the surface of an object. A multi-purpose meter can measure the dosage of neutrons and the remainder dosage of gamma rays. Some advanced countries are now developing a remote-controlled radiograder that can measure radiation in areas not reachable by personnel or vehicles. An individual dosimeter can determine the dosage of gamma rays irradiated on personnel in a contaminated area, and certain types can even measure the dosage of gamma rays in an instantaneous explosion. An aerial detector can find out the radiation rate in a large contaminated area. The U.S. "automatic aerial detecting system" is equipped with a radar altimeter, automatic recorder and coordinate programmer which enable the measurement and fast reading of the radiation rate to be carried out at an altitude of 1,500 meters.

At present, the Soviet troops are equipped with "BP M-PX" antichemical detecting vehicles. Installed on them are vehicle-use toxin alarms, detecting instruments, radio communication devices and radiograders as well as automatic indicators which enable the personnel inside the vehicles to measure and display the findings without disembarking.

In addition, such instruments as the light radioactive particle counter, laser radar and mass spectrometer are generally used for the detection of bacteriological warfare aerosol. Laser radar, for example, has the function of generating a laser beam that bounces back when hitting aerosol and shows on the radar beam indicator for the people on duty to judge the location and density of the aerosol, and of automatically giving warning signals.

6. Timely and Rapid Elimination of Aftermath Effects

After an enemy attack with nuclear, chemical or bacteriological weapons, it is essential to find out the situation rapidly and eliminate the consequences as soon as possible so that military personnel and civilians can obtain and maintain their freedom of movement. The situation to be determined involves the attack site, nature, range and degree. Based on the initial findings, measures are taken immediately to eliminate the consequences of the attack, and the main aspects of the measures include positive rescue, fire extinguishing and rush repair, disinfecting and contamination-elimination, and testing and sanitizing contaminated food and drinking water.

The methods used to eliminate radiative contamination include washing, rubbing (including rubbing with a solution), sweeping, patting, shaking and vacuum cleaning, subject to the situation. The methods used for disinfecting include spraying and rubbing with solution the surface of the infected object to eliminate toxic drops or liquid thereon; disinfecting precision parts is usually done by rubbing disinfecting solution on them. Scraping, covering and burning are the methods used to disinfect the surface of a ground or road. Applying disinfecting solution, boiling, sunning, covering, scraping and exterminating are used to eliminate bacteriological warfare agents.

Organizing positive rescue and rush repair is characterized by mass participation. Since it is impossible to rely only on professional troops to carry out positive rescue and rush repair in a vast damaged area, especially when there has been a nuclear weapon attack, it is necessary to carry out the "double rush repair" method with mass participation. After a nuclear attack, the rescuers, whether military personnel or civilians, must first rescue the people who are injured, especially those buried in collapsed defense positions or buildings. Meanwhile, they must pay attention to fires, which are easily spread, and extinguish them. Then they should make rush repairs on major and urgently needed defense positions, roads, bridges and other technical equipment and constructions. Likewise, after a chemical attack, rescue of the people who are poisoned, especially those having compound wounds, should be made a priority. After an attack by bacteriological warfare agents, the people who are contaminated by germs should be isolated without delay, the contaminated area cordoned off, and the routes of dissemination cut off; then disinfecting and sanitation treatment should be performed separately. This task should be linked with the patriotic campaign on public health participated in by the masses in peacetime.

When disinfection and elimination of contamination, based on the ascertained situation, are being organized and conducted, the first things to do are to give full play to the capabilities of the troops and masses in carrying out the "double rush repair" by themselves, and paying attention to the development of large, fast-moving vehicles and equipment. For contaminated personnel, disinfection and elimination are carried out mainly by vehicles with hot water for showers or those

with germ-eliminating facilities. For weapons and equipment, they are chiefly done with high-pressure water or disinfecting and contamination-eliminating vehicles. When no special facilities are available, spray trucks, fire engines and water pumps can be used, connected to rubber hoses. The navy and air force may fully utilize the water supply systems at their bases, ports and airfields to do the job. At present, a vehicle able to disinfect and eliminate contamination at a relatively fast speed is one developed by the Soviets, which can complete the job on all the tanks of an armored battalion within 30 minutes.

For the ground surface and roads, disinfection and elimination of contamination are generally not done in a large area. Key-point treatment is given only to such targets as important roads, bridges, airfields and ports, and the methods employed include chemical treatment, scraping, covering and burning, depending on the conditions and nature of contamination of the targets. For grain fodder, disinfection and elimination of contamination are done by wind-blowing, washing with water, surface scraping or husk removal; for drinking water by boiling, soil purifying or filtering. The treated grain and drinking water are generally tested by the public health department to determine their consumability.

In sum, when fighting an enemy that uses nuclear, chemical or bacteriological weapons, we could suffer a severe loss if we do not have reliable and effective protection against such weapons. However, we should be able to reduce or avoid a loss if we can grasp the rules followed by the enemy for the use of these weapons and the properties and special features of the weapons, get prepared in peacetime, and carry out close protection against such weapons in wartime. Doing this will affect not only the safety of all members of our armed forces and the masses, but also the winning of each and every war or battle with a small price.

Chapter 10: Electronic Countermeasures

I. An Important Means of Operations

The development of modern science and technology has made for a wider application of electronic technology in military use day by day. All modernized weapons such as artillery, tanks, airplanes, warships, guided missiles and satellites are correspondingly equipped with radar, communication devices, infrared or laser devices. Collection of information, command of operations, control of weapons, and coordination among the services and branches of the armed forces in modern warfare all rely on **electronic equipment** of one type or another. whenever and wherever electronic technology is applied, there is bound to be competition over electronic technology, therefore a completely new area of competition--electronic countermeasure operations--has emerged in modern warfare.

1. What Are Electronic Countermeasures

Generally, people think of electronic countermeasures as an electromagnetic war conducted by two hostile parties with electronic equipment and instruments that can reflect and absorb electromagnetc waves. In some countries, it is also called a war of electronics or a fight of radio electronics. Although no weapons are visible, this type of warfare still has a decisive impact on the outcome of a war or battle.

There is no mystery in electromagnetic warfare at all. In a thunderstorm we can often hear a knocking sound on the radio and see streaks and spots on the television screen; this is interference caused by electromagnetic waves generated by the lightning and thunder. Likewise, electronic equipment such as radar or a radio station is disturbed by useless signals from electromagnetic waves when it undiscriminatingly receives all of the electromagnetic waves from the same direction, on the same frequency and at the same time, disregarding whether they are useful or useless and whether they originated from us or the enemy. Thus, the receiving of the useless electromagnetic signals creates interference. When the interfering signals are stronger than the useful ones and cannot be eliminated, the equipment is certainly unable to function normally or does not function at all.

Two hostile parties can both take advantage of this feature of electronic equipment. When one side is capable of making equipment able to emit interfering signals or an instrument able to change the properties of electronic signals, it can interfere with or deceive the other side's electronic equipment and meanwhile destroy it with firepower. In order to accomplish these jobs, the first and foremost task for either side is to find out the type, special features, working frequency, location and changes in situation of the opponent's electronic equipment, but this cannot be done without reconnaissance equipment made for electronic countermeasure operations. However, since electronic countermeasure operations are conducted between two hostile parties, one of them must carry out electronic countermeasure reconnaissance and apply electronic

jamming and destruction to undermine the normal operation of its enemy's electronic equipment, while the other party has to adopt a series of defensive measures including counter electronic countermeasure reconnaissance, counter electronic jamming and counter destruction to ensure uninterrupted and normal functioning of its own electronic equipment.

2. Development of Electronic Countermeasures

The history of electronic countermeasures can be traced back to the beginning of this century. As soon as radio was applied to military communication, a simple radio communication countermeasure featuring interception and decoding budded and became a prelude to electronic countermeasure operations. During World War II airplanes were widely used in military operations. But because of the fast speed and long flying range of airplanes, optical equipment was no longer able to meet the operational requirements and thus radar was invented. To deal with the threat from radar and to protect itself, an airplane, while in operation, had to try its best to avoid detection by radar or, when spotted, to escape from or weaken the efficiency of the surveillance as soon as possible. Consequently, radar countermeasures came into being. After World War II, as gun sight radar, missile guidance radar and airplane interception radar were widely used, a weapon's percentage of hits was greatly improved, and fierce electronic countermeasure operations therefore unfolded around arms control and counter arms control. In the last two decades, military photoelectronic technology has had a fast growth and the application of infrared, laser and televisual technology to survey, guidance, surveillance, control and communication has intensified, thus making photoelectronic countermeasure operations fiercer than ever. As a result, a light wave band is added to a radio frequency band upon which the frequency chart of an electronic countermeasure is based.

Along with the emergency of military earth satellites and ICBMs, electronic countermeasure operations have now entered the realm of space technology extending the range from surface, ocean and sky to outer space.

All countries in the world, especially the two practicing hegemony--the U.S. and the Soviet Union--are paying close attention to electronic countermeasures. The U.S. holds that "Like the surface, ocean and sky, the electromagnetic environment is now emerging as a medium for operations. Before the 18th century, the armed forces were basically organized around the army. In the 19th and 20th centuries, the navy and air force rose separately. In the 21st century, electronic troops will stand out." It also deems that the outcome of future wars will possibly be determined by which one of the two warring parties can obtain preponderance in electronic warfare over the other. Based on this cognition, both the U.S. and the Soviet Union are doing their utmost to develop electronic countermeasures and investing in this an almost equal amount of money, which is increasing annually. The U.S., for example, has spent over $1 billion on it each and every year

since 1975. In 1978, its budget for electronic countermeasures made up 34.9 percent of the total budget of $3.85 billion for the development of military microwave technology and equipment, far more than the funds used for the development of radar, communication and navigation, instruments and equipment for guidance and control. In the area of organizational structure and development of troops, the Soviet armed forces have established a unit for electronic countermeasures in their general staff headquarters and all military services and regions, while the U.S. has formed an identical setup in its Department of Defense, Army, Navy and Air Force. Meanwhile, both countries have included a component exclusively for electronic countermeasures in the army units above the division level. In the field of scientific research and production, the U.S. has engaged as many as 200,000 people in research on electronic countermeasure technology. Since World War II, it has developed more than 400 types of equipment for electronic countermeasures and about 200 of them have been produced and deployed in its military units. The Soviet troops have also been equipped with a large number of electronic warfare devices.

3. Important Function of Electronic Countermeasures

That more attention has been paid to electronic countermeasures is attributed to the fact that they have many important functions in modern warfare, of which the major ones are:

A. To provide important information for the formulation of plans for operations. Through electronic countermeasure reconnaissance, we can identify frequencies of the enemy's electronic equipment, such as radar and radio communication systems, and related technical parameters as well as the properties, types, quantities and locations of disposition of the enemy's weapons, thus enabling us to assess and determine the deployment of enemy troops and attempts at action. Such information is not only a prerequisite to an effective implementation of electronic countermeasures, but also an important basis upon which our plans of operations are formulated.

B. To foil the enemy's command of operations. Radio communication is the major means of communication used by the armed forces for command of operations. Since the enemy will rely solely on radio communication when its army, navy and air force take joint action, its tank groups make a breakthrough of our defense line, its airplanes and warships conduct a formation for airborne or landing operations, or its troops undergo a siege, we can cut off its contact, paralyze its command system and severly weaken its troops' strength for combat if we efficiently jam, deceive or destroy its radio communication equipment. During World War II, after placing the massive German forces under siege at Kaliningrad, the Soviet troops used jamming to neutralize the radio communication between them and Hitler. Despite all of their efforts, including 250 attempts at resuming radio contact with Hitler's headquarters, the German forces failed and were totally destroyed. As the captured commander of the German forces confessed, one of the

reasons leading to the forces' surrender was that they were cut off from radio contact with the headquarters. In addition, by skillfully carrying out radio activities as a feint and using radio equipment and camouflaged instruments to conduct a mock advance or assembly of our troops, concealing our true intentions, we can cause an illusion for the enemy and foul up its command system.

C. To cover the breakthrough of a defense line or an attack. Radar is an important means for air and sea defense, guidance and navigation for airplanes and warships, control of artillery and guidance of missiles. The type of radar that monitors ICBMs is also required to provide early-stage preparation for air defense operations and data needed by counter-attacking guided missiles. By conducting effective electronic jamming, deception and destruction of the enemy's radar system we can not only prevent the enemy from discovering targets, guiding fighters for interception and directing artillery and guided missiles, but also enable ourselves to cover our airplanes, warships and ICBMs to successfully break through the enemy's defense line and attack. In the third Middle East War in 1967, Egypt launched six Styx guided missiles against the Israeli destroyer "Ailate" (5337/2139/3676) and a commercial vessel outside of Port Said, of which four hit the former and two the latter. In the fourth Middle East War in 1973, by taking effective electronic countermeasures, Israel was able to make all of the 50 Styx guided missiles fired by Egypt and Syria against its warships miss their targets. On the contrary, because of their own lack of electronic jamming facilities and the electronic jamming of their radars conducted by Israel, the Syrian warships participating in this war suffered a fatal blow from the Israeli guided missiles.

D. To protect important targets. By deploying a land-to-air radar jammer in the vicinity of such important targets as airports, bridges and command posts to disturb the aiming radar on the enemy's bomber, we can foul up the bombing to increase the survivability of these targets. By disposing a land-to-land radar jammer near ground artillery positions to disturb the enemy's radar for detecting and calibrating gun emplacements, we can prevent the enemy from locating our artillery positions, thus enabling ourselves to effectively bring our guns into full play. By using camouflaged instruments to provide approximate counter-visible light, counter-infrared and counter-radar disguise for such targets as airports, bridges, artillery positions and tank groups, we can conceal the true targets and expose false ones to minimize the chance of destruction by enemy attack.

E. To ensure smooth accomplishment of our operational missions by bringing the effectiveness of electronic equipment into full play. In wartime we should adopt various effective measures of defense against reconnaissance, jamming and destruction for our electronic equipment and systems so that our radio communication can be rapid, accurate, secure and uninterrupted and our radar can have far and clear vision and conveniently guide the control of weapons. This task is significant to ensure smooth accomplishment of our operational missions.

In the following section we will discuss the past wars in which radar warfare was most used.

II. Electronic Countermeasure Reconnaissance and Counter-Electronic Countermeasure Reconnaissance

1. Mission and Equipment of Electronic Countermeasures

Military operations cannot be separated from information. If we desire to give the enemy an effective electronic jamming, we must obtain information on its electronic countermeasures, which can be done by conducting electronic countermeasure reconnaissance.

The mission of electronic countermeasure reconnaissance is to provide strategic and tactical information for the conducting of electronic countermeasure operations. With the special equipment for electronic countermeasure reconnaissance, we find and catch the electromagnetic wave signals transmitted by the enemy's radio communication equipment and radar, and test, identify, analyze and orientate them. Through reconnaissance, we ascertain what modes, working frequencies, call signs, service languages and rules for contact are used by the enemy for radio communication, how its radio communication networks are formed and where its radio communication equipment is located. As for the enemy's radar, we use reconnaissance to determine the working frequencies, the number of transmissions in each minute, the length of each transmission, the number of revolutions made by the antennas each minute and the locations. Based on the information obtained through reconnaissance, we can judge the category, usage, properties, location of deployment and degree of threat to us of the enemy's electronic equipment for radio communication and radar.

According to the nature of its mission, electronic countermeasure reconnaissance is classified into two categories: advanced reconnaissance and direct reconnaissance.

Advanced reconnaissance, also known as strategic reconnaissance, features reconnaissance conducted year-round against enemy electronic signals by using various means for electronic countermeasure reconnaissance for the purpose of collecting countermeasure information on all enemy electronic equipment and accumulating data used as an important basis for the development of our own electronic technology and equipment and the formulation of our countermeasures.

Direct reconnaissance, also known as tactical reconnaissance, is the reconnaissance carried out before conducting jamming and destruction of enemy electronic equipment as a means of getting rid of an enemy attack. It is actually the reconnaissance that we conduct against the enemy electronic equipment confronting us on the battlefield with the information on electronic countermeasures collected through advanced reconnaissance for a twofold purpose--to check and supplement the information we have already collected on the enemy electronic

countermeasures and to get a clear picture of the enemy situation we are facing so that we will have concrete information to serve as the basis for the jamming and destruction conducted by us against the enemy electronic equipment.

Regardless of the mission, the composition of all types of equipment for electronic countermeasure reconnaissance is largely identical. The major components include an antenna, receiver, terminal and antenna control system. When the electromagnetic waves emitted by the enemy reach the antenna of our equipment for electronic countermeasure reconnaissance, they are received and relayed to the receiver. After being amplified and going through a series of conversions, they become visible and audible signals and then are sent to the terminal where all kinds of parameters are displayed for observation, recording and analysis.

To cope with the requirements for operations, reconnaissance receivers of different frequencies and systems are usually grouped together and used for electronic countermeasure reconnaissance to enhance the interceptability of the enemy's electronic signals as well as the preciseness in measuring their frequencies and locations. Meanwhile, we control the receivers by computer so that we can rapidly determine the parameters and locations in connection with the frequencies used by the enemy's electronic devices and judge their nature. The self-defense electronic reconnaissance equipment in the weapon systems mounted on airplanes and warships have an all-directional electronic warning and identifying capability and can detect and assess the threats from all directions in a timely way.

2. Means of Electronic Countermeasure Reconnaissance

Electronic countermeasure reconnaissance must be conducted from peacetime all the way through the course of a war and by various means. The means mainly include setting up ground electronic countermeasure reconnaissance stations and using airplanes, ships and satellites equipped for the mission.

Ground electronic countermeasure reconnaissance stations are mostly set up in border and coastal areas and at locations where electronic countermeasure information can be easily obtained to continuously conduct reconnaissance against the enemy's electronic equipment mounted on airplanes and ships and installed on the ground. Reconnaissance stations are relatively convenient to use, but owing to topographical restrictions their range of detecting targets on the ground is comparatively small. When necessary, certain specially made electronic countermeasure reconnaissance devices can be dropped deep into a hostile country and they will automatically intercept and record all types of electromagnetic wave signals and send them back via satellite.

Electronic countermeasure reconnaissance airplanes not only have good mobility and fast speed, but they can also "climb high and see far."

They are able to carry out unscheduled missions in areas 300 to 400 km behind the enemy front where electronic equipment is relatively concentrated or against such equipment aboard enemy ships. However, they are subject to the limitations set by their flying time and space and the volume and weight of the reconnaissance equipment carried.

Electronic countermeasure reconnaissance ships have a long cruising radius and wide range of activity and can carry a lot of electronic countermeasure reconnaissance equipment. When disguised as "fishing boats," "commercial ships" or "oceanographic surveyors," they can sail close to the coastline and islands of a hostile country to conduct long-term and overall electronic countermeasure reconnaissance to collect information on the country's ship-mounted and ground electronic equipment. They are used as the major means of electronic countermeasure reconnaissance at sea.

Electronic countermeasure reconnaissance satellites can fly over any area on the earth without restriction and overlook it from a space several hundred to 1,000 km above to collect electronic countermeasure information in the depth of a hostile country. It is a more ideal means of electronic countermeasure reconnaissance. When reaching the space above a hostile country, satellites can intercept a great many electromagnetic wave signals and automatically record them and then send them back to the designated ground stations as directed when flying over them.

A comprehensive and coordinated use of all means for electronic countermeasure reconnaissance constitutes an electronic countermeasure reconnaissance system which can conduct reconnaissance against the enemy's borders, waters and deep in its territory as well as the electronic equipment aboard its airplanes and ships to collect relatively complete information on electronic countermeasures.

3. Measures of Counter-Electronic Couutermeasure Reconnaissance

Electronic equipment for radio communication and radar is bound to give out some of its technical parameters so long as it emits electromagnetic waves to the air. However, if effective measures are adopted, certain electromagnetic waves can escape enemy interception or, when intercepted, can turn into false signals. This is called counter-electronic countermeasure reconnaissance, and it is a routine task which can be carried out through the following measures:

A. Strict control of the emission of electromagnetic waves and the use of frequencies. The longer the time of emission of electromagnetic waves by electronic equipment, the greater the chance that they will be detected by the enemy. Hence, under the condition that the reconnaissance can be completed, we should reduce the time of emission to the minimum and strictly guard as secret the frequencies which are not to be disclosed. We must tightly control the time for activating radar for artillery control and missile guidance and reduce

its duration to the minimum. In order to prevent new electronic equipment from emitting electromagnetic waves to the open air as it would lead to the exposure of the equipment's functions, we should conduct the testing of it in a shielded chamber.

B. Deceiving the enemy by emitting false signals. In order to fool the enemy's electronic reconnaissance, we can use a radio station, radar or simple radiation source to emit unscheduled electromagnetic waves from false positions for deliberate exposure.

C. Building shielded units (stations). In ordinary times, the equipment installed in these units (stations) must not be activated. In wartime, they are used as substitutes when the units (stations) currently in service are being electronically jammed by the enemy and counter-jamming measures cannot be taken, or when the units are destroyed by the enemy.

D. Timely reporting of reconnaissance activities conducted by enemy airplanes, ships and satellites. When some of our electronic equipment is considered threatened by the enemy, we should turn it off or take other timely appropriate protective actions.

III. Electronic Jamming and Counter-Electronic Jamming

Radar is an "eye with good vision to see things afar" and radio an "ear with good hearing to hear things afar," but electronic jamming can seal them off to make the eye "nearsighted" or even "blind" and the ear "deaf," or can deceive them with tricks. Needless to say, blind and deaf troops cannot win a war.

Electronic jamming comprises source jamming and non-source jamming.

A. Source jamming: Source jamming, also known as positive jamming, is conducted with a certain type of electromagnetic wave emitted or relayed by a jamming transmitter which serves as the source of jamming. It is classified into overpowering jamming and deceptive jamming in terms of the quality of destruction caused to the electronic equipment.

Overpowering jamming is jamming by noises (clutter waves) that overpower the enemy's electronic equipment and make it inoperative. It can blind radar and deafen radio communication. After the radar receiver is overpowered by noises, "thatches" of various lengths appear on the range display screen and grow longer along with the increase in the noise volume and cover the detectable signal indicating the target's location, thus making the distance between the radar and the target unmeasurable. On the screen, the jammed picture is like a white paper fan ripped into strips in which the bright dot denoting the signal of the target is buried, thus making the target's position undeterminable. After being jammed by strong noises, the earphone of the radio communication equipment is full of uncontrollable and stinging sound which covers the incoming talking or the ticking of a telegraph message, thus disconnecting the contact between the equipment and its sources.

Deceptive jamming is jamming to deceive the enemy by using a jamming transmitter or a radio station to imitate the enemy's radio signals skillfully. To radar, deceptive jamming can cause errors in its measuring of the target's distance, position and speed, and foul up its surveillance and guidance, thus leading the enemy's artillery and guided missiles to miss the target. To radio communication, deceptive jamming can cause disruption by imitating its methods used for announcement and conversation, thus achieving the purpose of mixing the spurious with the genuine. For example, in 1943 German radio operators, with their American-accented English and dialect, tricked U.S. transport planes into flying over the joint British and U.S. fleet where the artillery aboard the ships mistook them for German bombers and fired at them, causing a heavy loss to the allied naval forces.

B. Non-source jamming: Non-source jamming, also known as passive jamming, is conducted against the enemy's radar by utilizing instruments that can strongly reflect or absorb electromagnetic waves. It was widely used in the Vietnam War, the Soviet invasion of Czechoslovakia, and the Middle East Wars. With a lot of metal pieces spread around them or material containing metallic powder painted on them, airplanes and warships reflect jamming waves that massively show on the enemy's radar screen and produce the same effect as overpowering jamming does to cover the signals originating from them. When under surveillance of enemy radar for gun sights or missile guidance, airplanes and warships intermittently release jamming objects as false targets to trick the radar and to provide protection for themselves. Passive jamming is relatively simple and economical and can jam all types of radar.

2. Devices and Equipment for Electronic Jamming

A. Electronic jamming devices: There are many types of electronic jamming devices. For example, for radio communication equipment and radar, there are the aiming jammer, blocking jammer and deceiving jammer. These types of electronic jamming devices are usually composed of an electronic reconnaissance receiver, jamming transmitter, antenna and device for guidance and control, and all of them can emit jamming electromagnetic waves.

When the aiming jammer is at work, it can quickly find out the technical parameters and directions of the working frequencies employed by the enemy's electronic equipment through the enemy's electronic signals. Its device for guidance and control rapidly guides the transmitter against those frequencies and changes the antenna's direction toward the position of the enemy's electronic equipment to carry out aiming jamming. If the enemy changes the working frequencies of its electronic equipment in an attempt to avoid jamming, the electronic reconnaissance receiver needs to search again within the range of radio bands used by the enemy's equipment and "trails and attacks" the new frequencies in order to resume aiming jamming.

The blocking jammer can conduct jamming in a wider range of frequencies to "block" the enemy's electronic equipemnt of smaller range of frequencies when changing its frequencies, this it achieves the purpose of jamming.

The deceptive jammer can use the special features of the enemy's signals to conduct jamming by emitting deceptive signals that are identical or similar to those signals.

To be adapted to the wartime environment of fierce and complex electronic countermeasure operations, modern electronic jamming devices are made to have an intensified jamming efficiency and a widened range of frequencies for jamming, thus enabling one jammer to possess a variety of jamming means and through computers to organize devices of different functions for electronic countermeasure reconnaissance and jamming into a consolidated jamming system. This system can not only automatically conduct analysis and assessment of signals of all types of electronic equipment employed by the enemy and, based on the extent of the threat from the enemy, determine the targets for key jamming, but can also rationally allocate its jamming efficiency according to time and space so that it can jam more than one piece of equipment. Meanwhile, while conducting jamming, it can select the proper device, determine the best mode and choose the most appropriate timing to make the jamming most effective.

B. Electronic jamming equipment: The equipment for electronic jamming is mainly items that can reflect or absorb electromagnetic waves such as jamming foil strips, false-target lures and camouflage equipment.

Jamming foil strips are like the foil wrapper on a cigarette pack and include metal thread, strip and sheet; metal-coated paper; fiber glass and nylon thread. They have a high reflectability against electrical waves from radar and a strong performance of jamming. Jamming strips are air dropped or contained in rockets or gun shots for launch to the air from the ground, in airplanes and on ships, and disperse to form jamming clouds. Since they are light, they can float in the air for several hours, thus providing a relatively long jamming.

False-target lures are reflectors used to deceive the enemy's radar. The most used type is called a radar allurement missile and it is like a small airplane in appearance. Although small in size, its reflectability against radar electrical waves is identical to or stronger than an airplane's, and its mobile speed is closer to an airplane's. It is usually launched before our airplane enters the range of the enemy's radar detection in order to let radar in the enemy's air defense system mistake it for our airplane and attack it as a target.

Camouflage instruments are mainly angular reflectors, electromagnetic wave-absorbing material for coating and camouflage nets, smoke and aerosols. They can enhance or reduce a target's reflecting property

against electrical waves to confuse the enemy's radar and photoelectronic equipment. They are usually used to imitate or cover such targets as airports, bridges, ships, tanks and ground installations from being discovered, identified and attacked by the enemy's radar and photo-electronic equipment.

C. Application of electronic jamming devices and equipment: According to their properties and different usages and the requirements of combat missions for them, electronic devices and instruments have various modes of application. They may be installed in a ground jamming station or aboard an airplane or ship.

A ground jamming station is mainly used to conduct jamming against enemy electronic equipment on the ground or aboard an airplane or ship.

An electronic jamming airplane can carry many types of electronic jamming devices of different bands and passive jamming equipment, and conduct jamming and deception exclusively against all types of radar and radio communication equipment in the enemy's air defense system to provide cover for our bombers when making a breakthrough of the enemy's defense line. A combat airplane also carries a jamming device and equipment for self-protection and self-defense.

The Navy has ships specially equipped for electronic jamming, but most of its combat ships carry their own electronic devices and equipment to cover the formation of ships and for self-defense.

Besides, jamming can be implemented by unmanned or manned airplanes, balloons, rockets or a small jamming device which is thrown to or laid at the front of the enemy's position or near its command post.

In actual combat, jamming by a single measure always produces less effective results, while a consolidated application of all types of electronic equipment does a better job. In June 1944, the allied British and U.S. forces set a classical example in the use of electronic warfare jamming during the Normandy landing. The story is as follows:

(1) Beating the enemy at its own game by deceiving it: As the Nazi headquarters had arbitrarily presumed that the landing would take place in the Calais area, the allied forces purposely set up a group of radio stations of a fake command post at Dover to transmit frequently properly worded but false telegraphic messages and intentionally leaked them to trap Hitler into the illusion that the allied forces would indeed land at Calais.

(2) Gouging out the "eyes" and removing the obstacles by implementing close reconnaissance: The allied forces implemented close reconnaissance on the German radar stations, jamming stations, warning stations and radio stations deployed along the French coast. On the eve of the landing, 2,000 sorties of bombers and fighters were dispatched to attack

them, destroying all of the jamming stations and over 80 percent of the radar stations, thereby gouging out the "eyes" of the German forces and assuring the allied forces of a normal operation of their radar and radio stations.

(3) Making a feint to the east and attacking in the west by skillfully employing a strategem: On the eve of the landing, the allied forces dispatched groups of small boats mounted with angular reflectors and drawing aluminum-coated balloons to sail to the Calais area and air-dropped jamming foil strips above those boats to trick the remaining German radar stations into mistaking the boat groups for a large fleet moving to Boulogne under cover of a huge number of airplanes. In addition, the allied forces air-dropped mannequins and fake paratroopers made of angular reflectors along the coast near Calais to create the illusion that the area was under a large-scale attack. By so doing, a great number of the German troops were pinned down in the Calais area thus reducing the pressure on the allied forces who were fighting for the Normandy landing.

(4) Winning the battle with an ingenious military move by conducting electronic jamming: At the beginning of the landing, the allied forces mobilized 20 jamming airplanes to blind the remaining German radar stations, thus providing cover for the flight of a large group of their airplanes to the war zone. Simultaneously, a large surprise attack fleet had already been making a concealed advance, and was discovered by the German troops at a point only 10 nautical miles from the landing site because of the loud sound of its engines. However, by this time, five surprise attack divisions totalling 200,000 men had already landed at Normandy, creating an unmanageable situation for the German forces.

In his memoir, Sir Winston Churchill, the then British Prime Minister, wrote about this battle: "The achievement made by all kinds of measures to confuse the enemy before and after the launch of our attack was astonishing and had a far-reaching effect in warfare."

3. Means of Counter-electronic Jamming

Counter-electronic jamming has the mission of eliminating or weakening the influence of jamming, thus it is also called antijamming. Following are the methods usually applied to accomplish this mission:

A. Enhancing the electronic equipment's own antijamming capability: There are two ways to eliminate jamming of electronic equipment--to deny admission of jamming signals to the receiver or to separate useful signals from jamming signals which have already entered the receiver. The methods to achieve them include widening the equipment's frequency band so that when being jammed it can rapidly move to an unjammed frequency to continue its operation; increasing the equipment's transmitting efficiency so that useful signals can be made stronger than the jamming ones, just as a person must raise his voice while on

a noisy street if he wants to be heard by other people; adopting a special communication mode, such as classifying and coding, so that the enemy will find imitating difficult and jamming impossible; and developing a new system that has a strong antijamming capability for electronic equipment, such as single pulse radar, swift frequency change radar, moving target indication radar, intercontrolled array radar, as well as swift communication, meteoric aftertrack communication and satellite communication.

B. Utilizing tactical means to counter jamming: In a complex, changing environment of jamming, one unit of electronic equipment always has a limited antijamming capability. However, an electronic network can bring its whole antijamming capability into full play if its radars of different bands and systems are laid out in a staggered pattern to supplement one another. For guided missiles, overlapped guidance conducted by radar, infrared and laser devices should be adopted so that the guidance will still be available when one of the three loses its jamming function. For radio communication, various communication means should be used simultaneously so that the remaining ones can still be in operation when one is cut off and the ensemble function of the communication network will stay intact. The enemy cannot easily conduct jamming when we use such methods as relaying information through a cutout or transmitting the same telegraphic message by several radio stations. Frequent change of call letters, frequencies and code words can make it difficult for the enemy to trace them.

C. Intensifying the training of and elevating the level of operating skills: When electronic equipment has a strong capability for antijamming, it only possesses the possibility of eliminating or weakening the jamming, and such a possibility can be turned into a reality by human operators. Hence, whether the operators are familiar with the operating skills or not becomes the key to countering the enemy's jamming. As long as they have received the most difficult and strict training in peacetime and their level of antijamming operating and skill in distinguishing useful signals from confusing ones is elevated, they will be able to give full play to the function of electronic equipment and to win the struggle of electronic jamming with the enemy.

4. Destruction and Counter-destruction

Electronic jamming does indeed pose an enormous threat to electronic equipment, but it can only temporarily downgrade or weaken the equipment's efficiency even if it is very strong. The equipment will resume its normal operation as soon as the jamming has ceased. Destruction, therefore, is the most thorough and effective means to stop electronic equipment from functioning. Under certain conditions, this task is usually carried out by artillery, the air force or an armed detachment. Mentioned below is the air-to-surface guided missile, also known as the antiradiation guided missile (ARGM), which is used exclusively for attacking and destroying electronic equipment.

The ARGM is a special electronic countermeasure which came into being along with the developemnt of technology and equipment for electronic countermeasures. As pilots are most worried about being attacked by the enemy's air defensive weapons while flying over a battlefield, the ARGM was designed as an offensive weapon in answer to this problem. It is a guided missile employed specially to destroy AAA aiming radar, missile guidance radar and fighter guidance radar in the enemy's air defense system and to provide cover for our airplanes when making a breakthrough of the enemy's defense line. It is therefore called a counter-radar guided missile.

An ARGM usually consists of four parts, viz. a homing head, warhead, control system and engine. After a missile-carrying airplane is under surveillance by enemy radar, the receiver in the missile's homing head immediately catches the radar's electromagnetic waves and the control system will direct the missile after its launch to fly automatically along the radar's beam toward the radar and destroy it.

When used on the battlefield, the early stage ARGM had many defects and could be easily countered by radar. To make the ARGM adaptable to the requirements for operations, some improvements have been completed and the new type of ARGM is now equipped with the following: A) A "memory" which enables the missile to "memorize" the location of the enemy's radar and fly on the correct course to it even if the radar is turned off after the missile is launched. B) Expanded ranges of firing and flying speed, a widened range of frequencies for the missile's receiver, enhanced counter-jamming capability and upgraded precision of impact which enable the missile to catch and attack its target accurately. The tendency in future development of the ARGM is toward design of a type of "one missile for multiple purposes," meaning that the ARGM can carry out different missions at different times whan a homing head for the mission is installed on it, and that its rate of hits increases with a new mode of guidance which turns the missile's radar guidance from single to double or multiple when it transits from the starting point to the receiving end. This type of ARGM can not only become an important weapon in itself, but is also likely to be developed into a weapon having the capability to hit all types of electromagnetic wave-radiating electronic equipment.

Many counter-ARGM methods have gradually been discovered through practice. They include strictly controlling the activation of our radar and shortening the distance between the activated radar and the ARGM-carrying airplane in order not to give the enemy's airplane enough time to aim at and attack our radar, skillfully operating several of our radars alternately after the enemy's guided missile is launched in order to trick it to go off our radar beam and miss its target, utilizing various forms of surveillance carried out by radar, infrared or television devices and making flexible changes in them in accordance with the modes used by the enemy in guiding its ARGM in order to cause the missile's homing head to malfunction, and building strong defensive

fortifications and employing elevatable antenna. By so doing, we can reduce the loss of weapons and personnel even when our radar station is hit by an enemy guided missile.

The most significant feature of an electronic countermeasure is that it makes no mistake and changes fast as far as aiming at a target is concerned. In modern wars, the types of electronic equipment for battlefield use are many and the measures for dealing with electronic countermeasures are variable. Each measure is designed to be effective at a certain time and in countering one or several types of electronic equipment, and it becomes totally useless when the time has passed or improvement has been made to the target equipment. Thus, to attain victory in electronic countermeasure operations fully depends on rapid and accurate collection of information on the opponent's electronic countermeasures and on swift and sound changing of one's own tactical and technical electronic countermeasures. Only by seriously doing a good job on electronic countermeasures in all respects in peacetime can we bring their power into full play in wartime.

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